

THE ANVIL CHORUS

ANVIL-4000L

The largest, most advanced CAD/CAM software package available to industry . . . an integrated design, management information and manufacturing system. It provides the capabilities for engineers to fully automate the design and manufacturing of a product.

Unlike pre-packaged turnkey systems, ANVIL-4000L can run on most of the world's wide-word (24 bit to 64 bit) computers and use virtually any of the new graphics display tools. It will easily adapt to new technology as it comes along. Your current hardware may be just fine. At least you're assured of maximum flexibility . . . no lock into hardware that may soon become obsolete.

ANVIL-4000S

A modularized version of ANVIL-4000L designed for 16-bit minicomputers.

ANVIL-3000 SYSTEMS

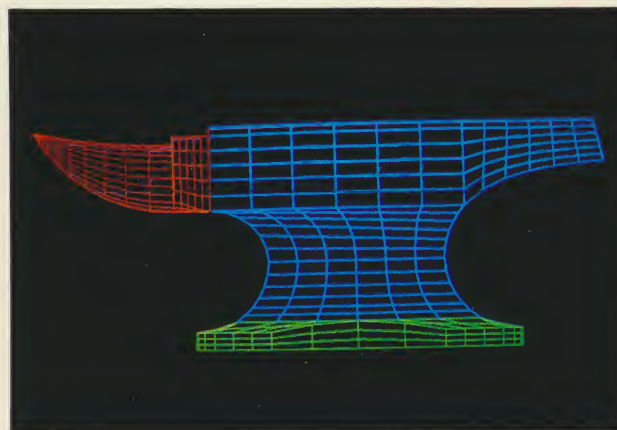
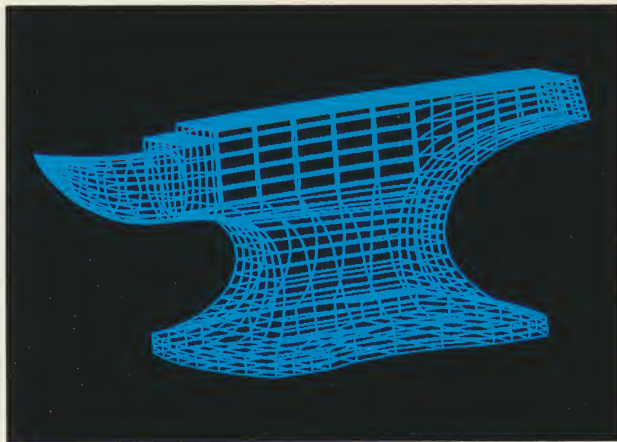
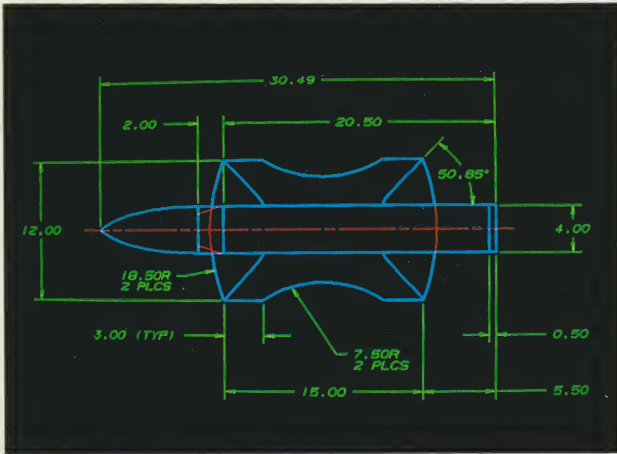
Complete mid-range turnkey CAD/CAM systems which deliver most of the power of the ANVIL-4000 software at a hardware/software price starting at less than \$100,000. The system includes a powerful Hewlett-Packard 1000F computer and all of the interactive and data-storage peripherals required for CAD/CAM operation. The computer itself has excess capacity for other data processing tasks.

ANVIL GRAPHIC RESOURCE STATIONS

Semi-autonomous units operating under ANVIL software. They have enough local CAD/CAM capability to reduce the host computer I/O traffic by as much as 80%. They can be used to expand existing CAD/CAM systems and serve as the basis for distributed CAD/CAM processing networks.

ANVIL GRAPHIC RESOURCE CENTERS

Time-sharing facilities which bring the full capabilities of the most advanced CAD/CAM system to the small to medium user. A time-sharing installation can also serve as a test bed for companies who are evaluating CAD/CAM in their own operations. The investment is limited to the lease of a Graphics Resource Station and the computer time used.



ANVIL-4000™ - THE AUTOMATED DESIGN, DRAFTING AND MANUFACTURING SYSTEM

ANVIL-4000 spans the man-computer communication gap by providing a totally computer-independent data base for all Computer-Aided Design/Drafting, Computer-Aided Engineering, Management Information and Computer-Aided Manufacturing operations, as well as a complete data base for other applications.

ANVIL-4000 is available in two forms: an interactive language which is comprised of a set of interactive graphic procedures and a written language, GRAPL.

INTERACTIVE LANGUAGE: These procedures turn the CRT into a drawing board of any size, allowing representation of all designs in a simple and efficient way. Automatic procedures include scaling, zooming, mirroring, translation, duplication and rotation. This insures maximum use of the time when a designer is actually operating the screen "laying down light."

GRAPL: The written language of ANVIL-4000 allows geometric definition to be prepared off-line in a form which generates the same data structure as the interactive graphic definitions. The statements can be read into the interactive graphic system where the written geometry definitions are displayed as if they had been defined interactively. Thus a design generated at a desk receives the benefits of graphics and increases the system through-put by allowing parallel geometry definition.

Some ANVIL-4000 components are:

Geometry Generation	View and Scale Manipulation
Geometry Manipulation and Grouping	Mechanical Drafting
Families of Parts Facility	Geometric Analysis
File Management	Numerical Control
Management of Information	User Applications

While ANVIL-4000 provides complete capabilities in the above areas, MCS realizes that it is difficult for an "off-the-shelf" facility to fill all of the requirements for any given organization. (Even two companies in the same discipline seldom operate in an identical fashion.) Therefore, ANVIL-4000 was designed with the flexibility which allows each user to customize his own environment. Examples of applications which presently exist or are being added to ANVIL-4000 are:

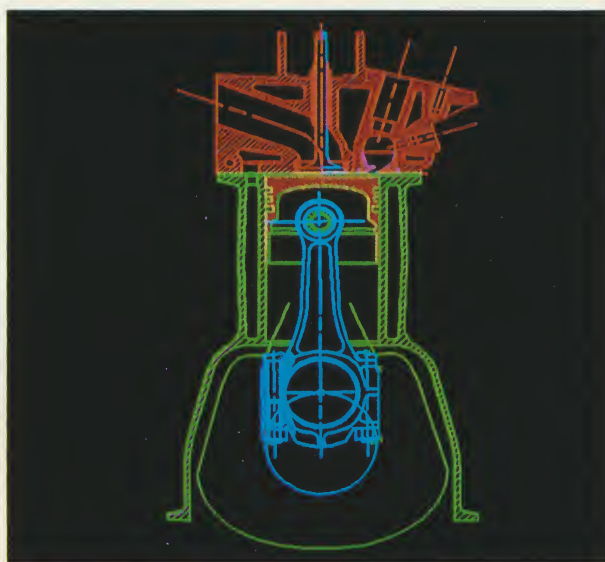
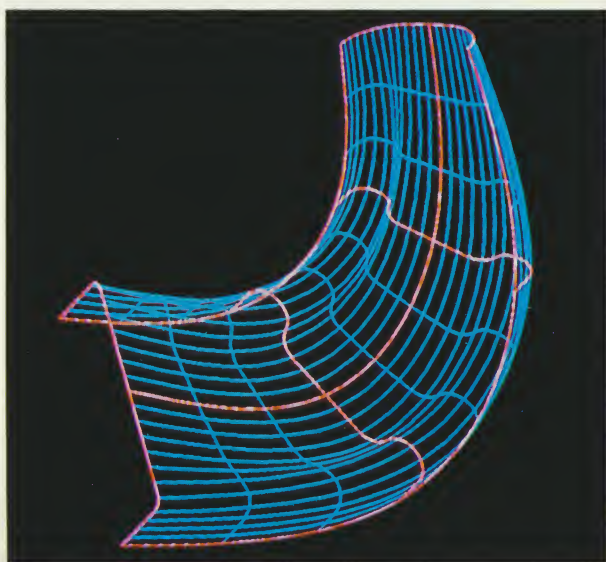
Cadastral Mapping	3-D Packaging
Electronic Design/Drafting	Sheet Metal Bending
Finite Element Modeling	Piping Layout
2-D Nesting	Utility Management

ANVIL-4000 can also interface with virtually any existing design, analysis or data base management system, thus insuring total integration of design, management information, drafting and manufacturing.

ANVIL-4000 is a trademark of Manufacturing and Consulting Services, Inc.

GEOMETRIC ELEMENTS

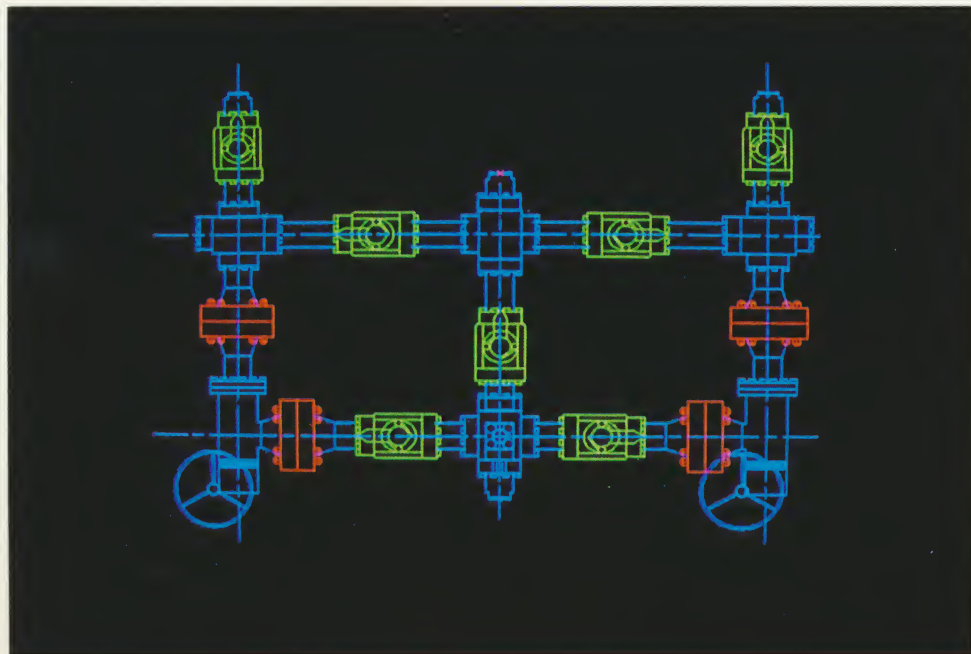
- Point
- Line
- Circle and Circular Arc
- Loft, Rho and General Conic
- Ellipse
- Parabola
- Hyperbola
- N-Gon
- String
- B-Spline
- 2-D and 3-D Cubic Spline
- Vector
- Composite Curve
- Surface Intersection Curve
- Surface Edge Curve
- Draft Curve
- Plane
- Projected Entities
- Surface of Revolution
- Tabulated Cylinder
- Ruled/Developable Surface
- Curve Mesh Surface
- Bi-Cubic Mesh Surface
- Point Mesh Surface
- Fillet (Blending) Surface
- Offset Surface
- Curve Driven Surface
- Composite Surface
- Hexahedron
- Solids of Revolution
- Projected Solids
- Solids from Wire Frame Figures*
- Solids from Orthographic Projections*
- Solids Bounded by Arbitrary Surfaces*
- Composite Solids*
- Shells*



*Under Development

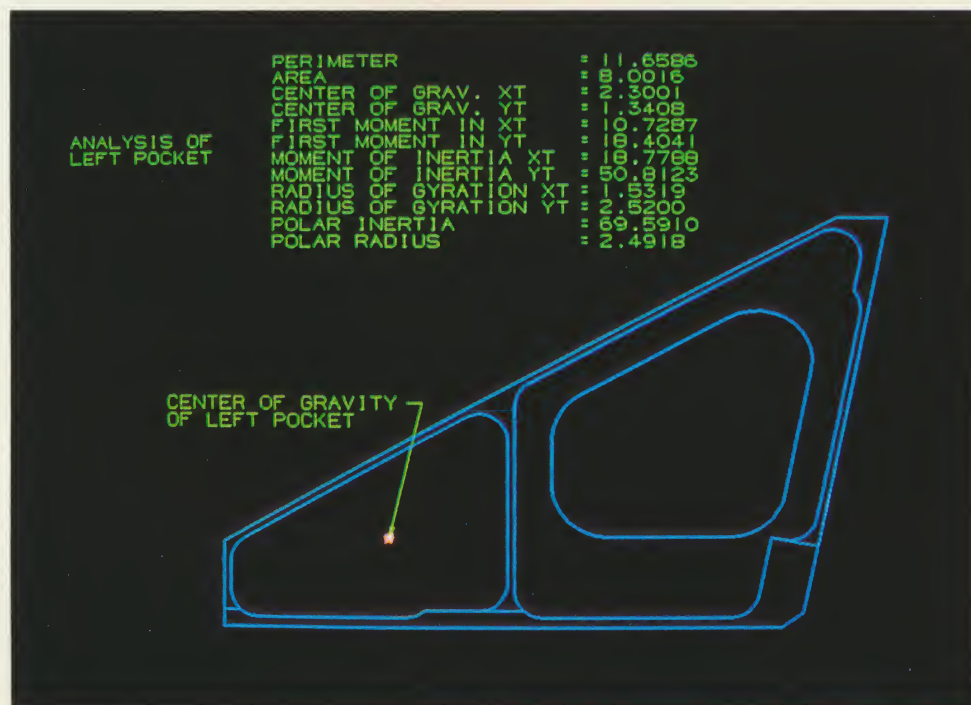
GEOMETRY MANIPULATION AND GROUPING

- 2-D and 3-D Translation
- 2-D and 3-D Rotation
- Duplication
- Groups
- Patterns
- Parts
- Templates
- Arrays
- Mirror
- Array Explode
- Stretch



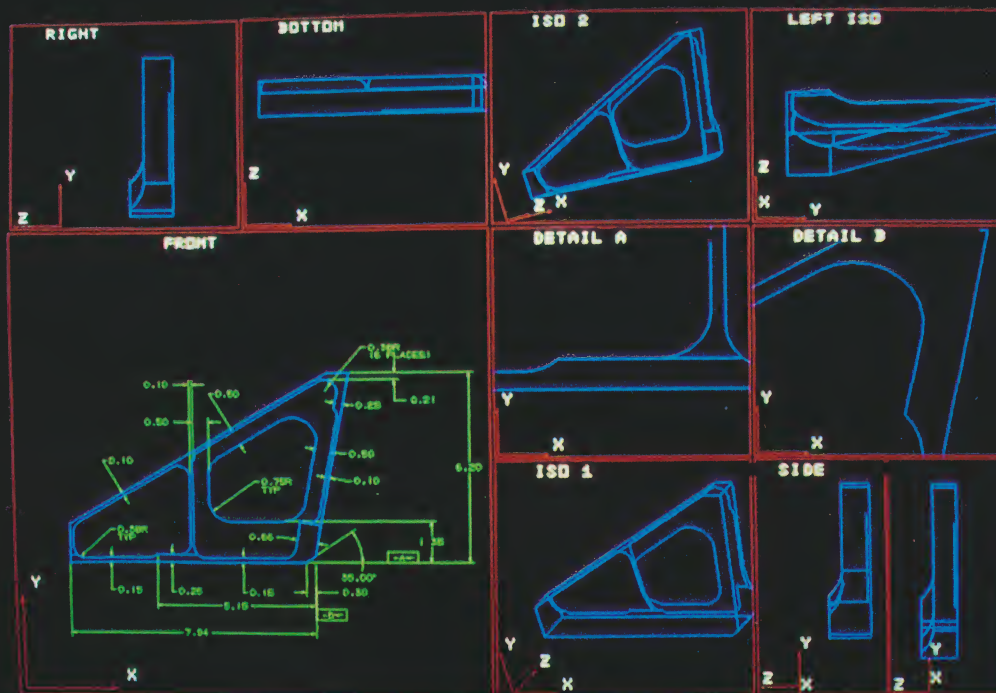
GEOMETRIC ANALYSIS

- Parameter Verification
- 2-D Section Analysis
- 3-D Analysis
- Curve Analysis



VIEW AND SCALE MANIPULATION

- Automatic Scaling
- Single and Multiple View (32 Simultaneous)
- Named View Layout Construction (i.e., View Placement and Size)
- Zoom (Entire CRT or Selected View) at any Time
- Unlimited Number of Views
- Auxiliary View Construction
- Isometric and True Perspectives
- Optional Display of View Vectors, View Borders and View Names
- Implicit and Explicit Depth Control
- Z-Clip
- Local Coordinate Systems
- Blanking
- Unblanking



FAMILIES OF PARTS

- GRAPL Programs
- Patterns
- Templates
- Part Merge Capabilities

FILE MANAGEMENT

- Part Management which includes:
 - Saving and Restoring ANVIL-4000 Parts in a Fast Format
 - Saving and Restoring ANVIL-4000 Parts in a Computer-Independent Format
 - Saving and Restoring ANVIL-4000 Parts in the I.G.E.S. (Initial Geometry Exchange Specification) Format
- Part Lists
- Part Deletion
- Part Library Compaction
- Pattern Management
- Template Management
- Shared or Separate Work Files

MANAGEMENT INFORMATION

- Bill of Materials
- Report Generator
- Graphing (Data Plot System)¹
- Security Control
- Part Release Control
- Accounting Procedures

MISCELLANEOUS

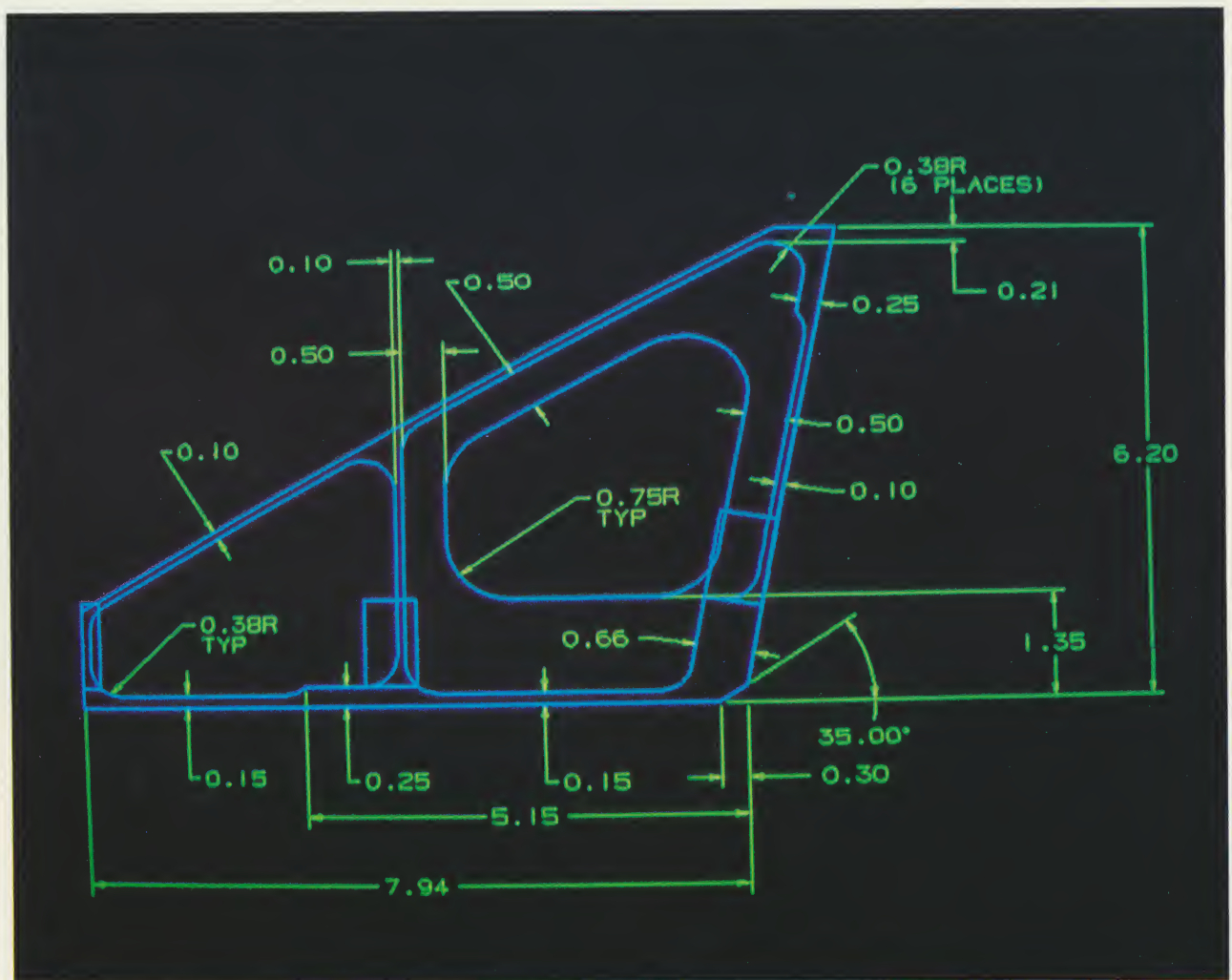
- Interactive Configurator
- Metric-to-English and English-to-Metric Conversion
- Entity Selection:
 - Picking
 - Chaining
 - Name
 - Sequence Number
 - Pointer
 - By Level or Range of Levels
 - Within a Region
 - Outside a Region
- Canon (i.e., Display Entity Canonical Form)
- Level Control (up to 1024 Levels)
- Modal and Font Control of all System and Application Parameters
- Tutorial (Help) Facility
- Pen Number Control by Entity
- Color Control by Entity
- User Controlled Precision

¹Not Available in ANVIL-4000S

DRAFTING FUNCTIONS

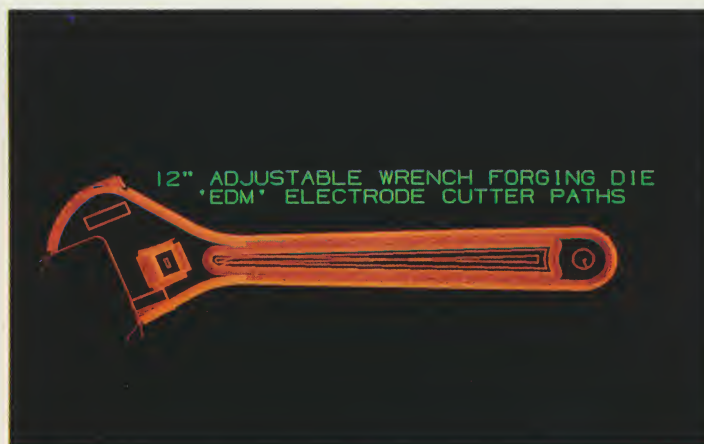
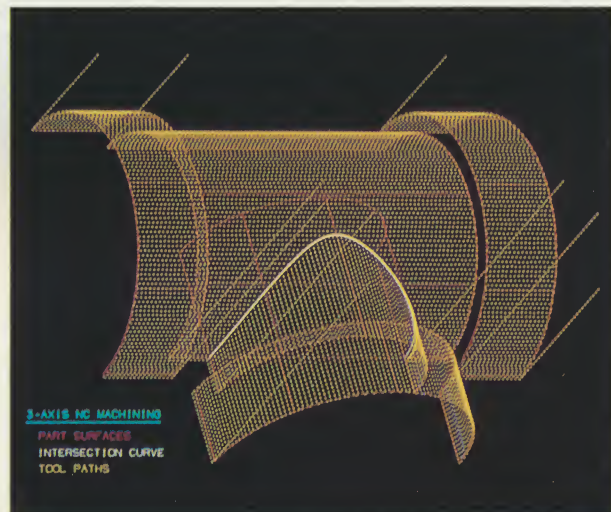
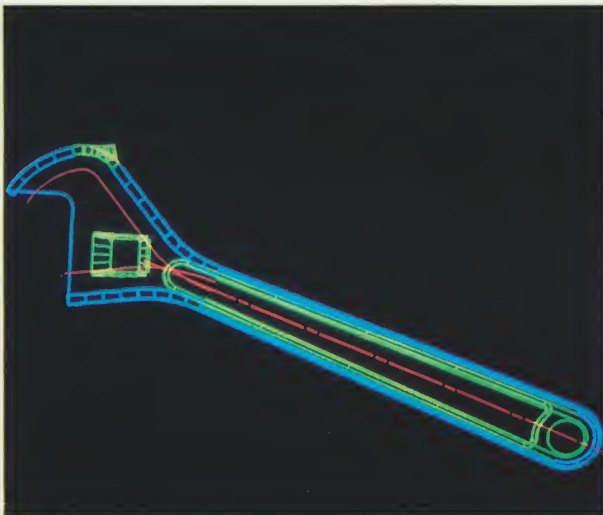
- True 3-D Drafting
- Drafting Modal Control
- Cross Hatching
- Horizontal Dimensions
- Vertical Dimensions
- Parallel Dimensions
- Angular Dimensions
- Circular Dimensions
- Diameter Dimensions
- Thickness Dimensions
- Automatic Dimension Regeneration
- General Notes
- General Labels
- Centerline
- Complete Drafting Entity Modification Capability
- Detail Magnification
- Balloon
- User Defined Symbols
- User Created Special Curve Fonts
- True Position Tolerance Symbols
- User Generated Drafting Standards

In essence, all of the facilities required to produce an annotated drawing



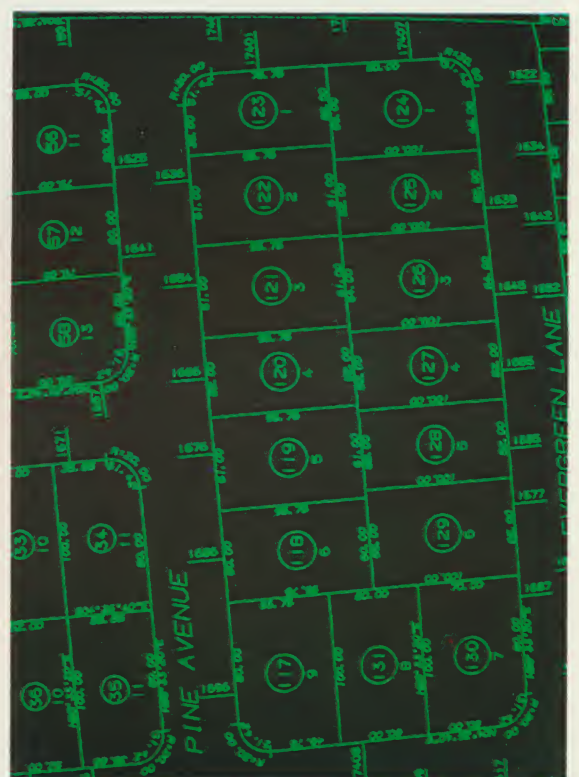
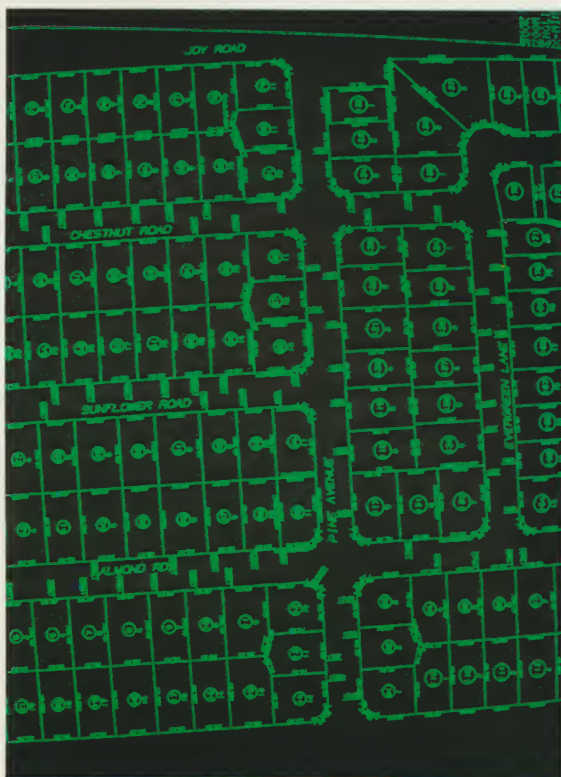
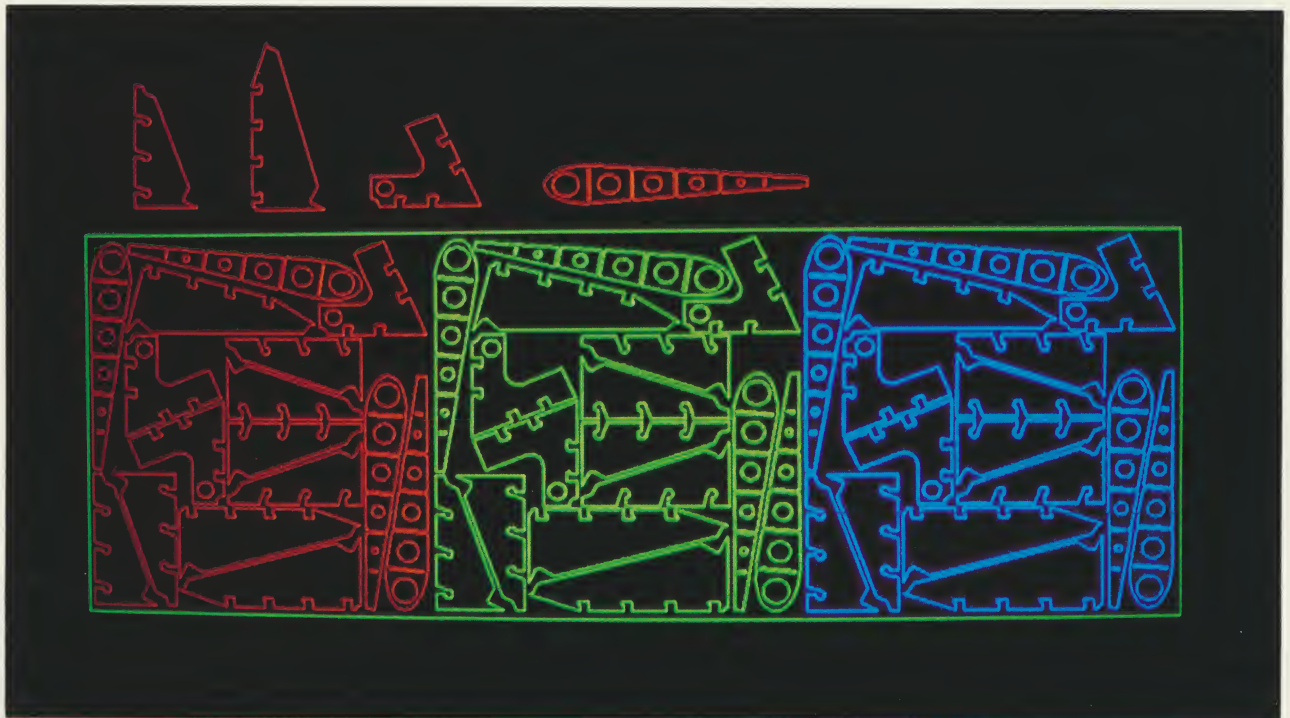
NUMERICAL CONTROL

- Numerical Control Modal Control
- Point-to-Point Operations with Built-in Cycles
- Pocketing (to Fixed Depth, Canted Plane or any Arbitrary Surface)
- Profiling (to Fixed Depth, Canted Plane or any Arbitrary Surface)
- 3-Axis Machining including Drive, Check and Part Surface, with Island and ZT Containment
- 5-Axis End Cutting
- 5-Axis Swarf Cutting
- Absolute Tool Motion
- Surface Profiling
- Surface Grooving
- Graphic Lathe Module
- Machining Curve Projected to a Surface
- Automatic Roughing Cuts
- Auxiliary Functions
- Circular Interpolation
- Cut Direction Control
- Total Tool Path Display, Modification and Edit Capability
- Cutter Geometry Control
- Lace and Non-Lace Cutting
- Rough and Finish Cuts
- APT Output
- APT CLFILE Output
- COMPACT II Output



APPLICATIONS

- Cadastral Mapping
- Electronic Design/Drafting
- 2-D and 3-D Finite Element Mesh Generation
- 2-D Nesting
- Pathing and Fabricating for Flame Cutting



HOW DOES ANVIL-4000 DIFFER FROM TURNKEY CAD/CAM SYSTEMS?

COMPUTER INDEPENDENCE

ANVIL-4000 operates on all 16 Bit*, 24 Bit, 32 Bit, 48 Bit and 60 Bit word computers. Since ANVIL-4000 is 100% Fortran, conversion to any computer not currently supporting ANVIL-4000 is a well-defined, mechanical process.

USER DESIGNED

ANVIL-4000 was designed by those people who have the greatest knowledge of what is required in a CAD/CAM system — the MCS Software Users Group. ANVIL-4000 growth and enhancements are guided by these same people.

DEVICE INDEPENDENCE

ANVIL-4000 allows the user to select the optimum display (storage tube, refresh, raster scan, black and white or color) for his application and price range. ANVIL-4000 also supports a variety of input forms, including single display, display and auxiliary message unit, tablet, function buttons, digitizer and data from external applications.

MODULAR

ANVIL-4000 is available in a variety of configurations. The user is only required to select those modules which fit his requirements. ANVIL-4000 modules can be added to and enhanced indefinitely.

APPLICATION COMPATIBLE

ANVIL-4000 is structured to allow simple interface with any existing application, or the easy addition of applications and enhancements to ANVIL-4000 itself.

OPERATES UNDER STANDARD OPERATING SYSTEMS

ANVIL-4000 runs as a task under any standard operating system. This allows for concurrent computational and informational processing to take place at the same time ANVIL-4000 is functioning.

FLEXIBLE

While "turnkey" does not necessarily mean inflexible, experience has shown that "turnkey only" vendors tend to supply packages "cast in concrete". Flexibility of both hardware and software is a desirable goal in system design, for it means rapid change can be affected with minimal error or disturbance. This was one of the most important considerations taken in the design of ANVIL-4000.

UNLIMITED GROWTH

Any standard computer hardware can be used for ANVIL-4000. The user can take advantage of the pricing and technological breakthroughs constantly occurring in the hardware industry. MCS will continue to be a partner to this hardware explosion by enabling its customers to exploit the potential of new computers and graphic hardware as they are introduced.

DATA BASE INTEGRITY

The integrity of an ANVIL-4000 drawing is maintained for the life of ANVIL-4000. Thus, a drawing created in 1981 on ANVIL-4000 can be retrieved in 1986 on ANVIL-4000 without the user being aware that any conversions for modified data structure are taking place. MCS guarantees that upward compatibility will be available as long as ANVIL-4000 is being produced by MCS.

CONTINUING ENHANCEMENTS

The MCS Software Users Group supplies MCS with ongoing requests for additions and enhancements to ANVIL-4000. MCS is committed to supplying the needs of the MCS Software Users Group by continually increasing the productivity of ANVIL-4000 as a design, management information, drafting and manufacturing system.

DATA COMMUNICATION ACROSS HARDWARE ARCHITECTURE

ANVIL-4000 is designed so that information generated on one computer architecture with ANVIL-4000 can be retrieved and transmitted to any other computer running ANVIL-4000. This allows for the use of all hardware within a company. It also provides for simplified communication between prime contractors and sub-contractors. There is no need for every division in a company or every organization working on a contract to use exactly the same hardware.

In summary, ANVIL-4000 is a computer independent system which allows the user to select a computer in the performance and price range to fit his needs. The user also selects the interactive display terminals and output plotters with options and performance to match his requirements. In addition, the user is allowed to use the hardware which currently exists in-house, rather than procuring hardware forced on him by a turnkey vendor. Any time the user desires to update obsolete hardware ANVIL-4000 tags right along.

*ANVIL-4000S - A smaller, slightly less powerful version of ANVIL-4000.

WHAT COSTS ARE INVOLVED IN EVALUATING ANVIL-4000?

The least expensive way of evaluating ANVIL-4000 is to lease a terminal from MCS and connect to an ANVIL Graphic Resource Center. Two types of terminals may be leased: a "dumb" terminal, which has the advantage of low cost and the disadvantage of fairly low rates of interaction; or the ANVIL Graphic Resource Station, which has a higher cost but a significantly higher rate of interaction. The lease rate (minimum three months) for a "dumb" terminal is \$1,750.00 a month including maintenance. The lease rate (minimum three months) for an ANVIL Graphic Resource Station is \$3,000.00 a month including maintenance. In addition, there are costs associated with the Timesharing itself. These costs can range from a low of \$400.00 a month to over \$2,000.00 a month, depending upon usage.

WHAT SUPPORT IS AVAILABLE FROM MCS AFTER ACQUISITION OF ANVIL-4000?

The MCS Customer Service Organization provides both "hot line" and normal maintenance and error processing. "Hot line" assistance is available from 8:00 a.m. to 6:00 p.m. (California time) five days a week. In addition, normal error/deficiency processing which does not impact actual production is processed the day that the error/deficiency report is received by Customer Service. If this error/deficiency report is received more than 30 days prior to a Revision, then the correction for the error/deficiency is normally included in the next Revision of ANVIL-4000. MCS also supplies emergency enhancement assistance for customers who have a specific requirement not met by ANVIL-4000, but necessary to meet the production goals of the customer. These customized enhancements are handled on an individual basis as the need arises.

WHAT TRAINING IS PROVIDED BY MCS IN THE USE OF ANVIL-4000?

MCS offers regularly scheduled training classes for ANVIL-4000 at the MCS facilities in Southern California during the second and third weeks of each month. The first week provides instruction in the basic concepts and capabilities of ANVIL-4000. It is an end-user oriented course. The second week is presented at the systems level for application and maintenance programmers. This week covers the internal structure of ANVIL-4000 and shows how to interface with other applications or to add applications other than those provided by MCS. In addition to the regularly scheduled classes, custom classes can be arranged at the MCS facilities in Southern California for specific subjects and/or areas of interest.

DO I HAVE TO BUY ALL OF THE ANVIL-4000 MODULES?

You are encouraged to purchase only those modules which will be useful for your particular operation at this point in time. As an example, it is quite common for companies to start with only the drafting package which consists of the base module and the drafting module. The additional modules and applications can be added to the system as the user desires to grow in the use of ANVIL-4000. By combining modules, ANVIL-4000 can be:

1. A drafting system
2. A 3-D design system
3. A manufacturing system
4. A specialized application system
5. A totally integrated design, management information, drafting and manufacturing system

IS A COMPUTER STAFF REQUIRED TO SUPPORT ANVIL-4000?

ANVIL-4000 has been designed by CAD/CAM users and implemented by the MCS technical

staff. The same staff that developed ANVIL-4000 is available to assist in whatever computer support is required for the maintenance of ANVIL-4000. Thus no in-house computer staff is required for the support of the ANVIL-4000 system. A large number of the MCS installations have been at companies in which no computer personnel were associated with either installation or after-the-fact support. MCS delivers ANVIL-4000 and its updates in a form which is compatible with the operating systems of all of the major computers upon which ANVIL-4000 runs. The only computer "talent" required by the customer is the ability to read a tape into the system using the standard input techniques for their in-house computer.

For those computers which MCS has in-house (Perkin-Elmer, DEC VAX 11/780, Prime, Harris and HP1000F), fully executable systems are available so that there is not even the necessity of compiling a single program. Typical installation time on any of the above computers can be as little as 30 minutes and seldom exceeds 2 hours.

WHAT HARDWARE IS REQUIRED FOR ANVIL-4000?

Four basic pieces of hardware are necessary for ANVIL-4000. These consist of a central processing unit, a disc, magnetic tape and interactive display. In addition, some users may desire the use of a plotter, a digitizer, tape punch equipment for N/C output, function buttons, tablets, alternate message displays, etc.

Sizing of these components is a function of:

1. The type of computer upon which ANVIL-4000 is expected to run.
2. The number of terminals to be tied into one computer.
3. The type of terminals (either intelligent or dumb).
4. The effective response time desired by the user organization.

It is always suggested that ANVIL-4000 have a dedicated disc if other applications are to be

running at the same time. The following minimum memory requirements are listed by computer category:

- 16 bit architecture ANVIL-4000S requires 64K bytes per user plus operating system
- 24 bit and 32 bit non-virtual architecture requires 180K bytes per user
- 48 bit and 60 bit non-virtual architecture requires 32K words per user
- 32 bit virtual architecture requires one megabyte for two users, two megabytes for four users, three megabytes for eight to twelve users, four megabytes for sixteen or more users.

The displays can be of any type currently supported by MCS.

The MCS ANVIL Graphic Resource Station more than doubles the number of terminals which can be handled in a virtual environment, or a non-virtual environment if sufficient memory is available in the non-virtual machine. Additional information on the ANVIL Graphic Resource Station is available upon request.

Disc size is another variable which cannot be determined without having some idea as to the number of drawings which will be maintained on-line in an active file. A rule of thumb, however, is 150 megabytes of disc for each eight users.

WHAT PERIPHERALS ARE SUPPORTED BY ANVIL-4000?

ANVIL-4000 supports all of the various input modes available for interactive graphic systems. This includes digitizer tablet, function buttons and any type of display (direct-view storage tubes, refresh, raster scan, color or black and white). All of these different input configurations and various types of output configuration, such as plot files and numerical control output files, can be run simultaneously on one computer.

DOES ANVIL-4000 PROVIDE ANY REMOTE PROCESSING CAPABILITY?

MCS has long recognized the requirement for communication with distributed networks and access to large computers over voice grade telephone lines. To fill that requirement MCS has spent several man years developing the ANVIL Graphic Resource Station. The philosophy of the GRS is to unload the host computer of all interaction including data entry, entity selection, repaint, zooms, windowing and view modifications; in essence, all of the items which require a high degree of input/output and demand instantaneous reaction for a user to remain effective.

The GRS reduces the input/output load on the host computer, significantly increasing the number of users which one computer can support. At the same time it is possible to communicate with the GRS over a voice grade phone line at speeds as low as 1200 baud while maintaining interaction at 150KB rate with the user. Thus, for those items in which the user must have instantaneous feedback, there is instantaneous feedback. For those areas in which the amount of time the computer should take is a fairly unknown quantity, such as calculating tool paths, intersecting surfaces, generating cross sections, (time in which the user does not expect rapid response), the small amount of degradation which is obtained by transferring data at low rates over voice grade phone lines does not impact the effective calculation time to a noticeable degree. Consequently, the ANVIL Graphic Resource Station allows remote processing with the same interactive capability as a user would have on his own dedicated host computer while operating at any distance over which communication can be established by a phone line or a standard RS232 interface.

HOW CAN ANVIL-4000 HELP INTEGRATE DESIGN, MANAGEMENT INFORMATION AND MANUFACTURING?

The data base of ANVIL-4000 provides for total geometric description of a component and allows for ancillary data to be associated with that component. This ancillary data, stored in the form of attributes, allows all of the information necessary for the design, management information and manufacturing processes.

In addition to the broad data base upon which ANVIL-4000 is built, there exists an underlying structure which allows for interfacing with other non-ANVIL-4000 functions such as the various analysis programs (finite element, electrical, circuit, hydraulic, etc.) required for the complete design cycle. ANVIL-4000 also captures information concerning the design process as it takes place. Accounting data, necessary to supply Management Information Systems with costs and time spent in the design and manufacturing process, is joined by a powerful Bill of Materials and Report Generator facility. These use the ANVIL-4000 attributes to allow for the extraction of any of the associated information which accompanies the geometric data.

After the design process is complete, the data which exists in ANVIL-4000 can be processed by the most extensive N/C capability in existence, and can be interfaced with a variety of other manufacturing disciplines such as process planning.

This complete integration of all aspects of component creation provides an integrated design, management information and manufacturing system.

DOES ANVIL-4000 INTERFACE WITH OTHER APPLICATIONS?

In the original design of ANVIL-4000 it was recognized that no single vendor can supply all of the applications required by the infinite variety of designs which exist in the world. For this reason ANVIL-4000 was structured to provide two types of application interface. The first type is the interface to applications which have broad acceptance across a large number of industries. For these specific applications MCS not only provides interfaces but has special pre-processors to minimize the amount of effort in using these applications and also supplies post-processors for returning the results of the analysis back into the ANVIL-4000 data structures. Examples of these applications are a variety of finite element analysis codes such as NASTRAN, MARC, ANSYS, SAP4, SUPERB, etc., and circuit analysis programs such as SCEPTRE.

The second class of applications are those which are neither so broadly distributed or which are generated by specific customers or sets of customers. For these applications ANVIL-4000 has a simplified data retrieval and data definition capability so that information can be extracted from ANVIL-4000 in almost an infinite variety, allowing an interface with virtually every type of application which uses any combination of geometric, arithmetic or alphanumeric data.

CAN I USE ANVIL-4000 AS A BASE UPON WHICH TO BUILD MY OWN APPLICATIONS?

For those organizations wishing to take advantage of their own in-house applications and in-house programmers, ANVIL-4000 acts as the perfect base upon which to build a large variety of applications and integrated systems.

A significant part of the effort to generate ANVIL-4000 goes into documenting the tools used in ANVIL-4000. These tools are readily available to organizations which would like to expand or enhance ANVIL-4000 for their own purposes. In addition, MCS supplies detailed documentation of the ANVIL-4000 data structure and all of the facilities necessary for communicating with ANVIL-4000, extracting data from ANVIL-4000 and enhancing the ANVIL-4000 data base.

MANUFACTURING AND CONSULTING SERVICES, INC.

17942 Cowan, Irvine, California 92714

Phone: (714) 540-3921

Twx: (910) 595-2790